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ABSTRACT

Many California school districts, in complying with the Class Size Reduction Program, will obtain relocatable classrooms directly from manufacturers who are under no specific guidelines or codes relative to indoor air quality (IAQ). This document, designed to aid school facility managers in minimizing potential IAQ problems, summarizes the indoor environmental quality (IEQ) considerations regarding the purchase/lease of relocatable classrooms and the contracting for renovation of existing space. The key IEQ concerns and preventive measures are provided for relocatable classroom design, construction/installation and first-use, and maintenance. Some issues apply to both relocatable and renovated classrooms. Resource information providing further technical details is provided. (GR)

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IAQ Info Sheet

ADVISORY ON RELOCATABLE AND RENOVATED CLASSROOMS

PURPOSE: This document summarizes the indoor environmental quality (IEQ) considerations regarding the purchase/lease of relocatable classrooms (or "portables") and the contracting for renovation of existing space. It is provided to advise school facility managers how to minimize potential health impacts from IEQ problems with cost-effective practices. The key IEQ concerns address design, construction/installation, first-use, and maintenance; some of the issues apply both to "portables" and renovated classrooms. A listing of related documents where further technical details may be found is also included.

A. DESIGN

The State Department of General Services (DGS) issues specifications on "Building, Classroom, Prefabricated, Relocatable General Requirements", which outlines the DGS requirements for the State Portable Classroom Program. The demand generated by the Class Size Reduction Program exhausted the available inventory of state lease program relocatable classrooms. Many school districts will instead obtain relocatable classrooms directly from manufacturers. Although all classroom units manufactured for California must conform to the Building Standards Code (Title 24), these standards are not specific for "portables". Hence, these relocatable units may not adhere to the DGS specifications, and their design and quality can vary.

Ventilation and Outdoor Air

For the design of heating, ventilation, and air conditioning (HVAC) systems, the ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Standard 62-1989 **Ventilation for Acceptable Indoor Air Quality** recommends 15 cubic feet per minute (cfm) per person of outdoor air for school classrooms. This value has been incorporated into the California Energy-Efficiency Building Standards. The DGS bid specifications for Relocatable Classrooms require that HVAC systems deliver a minimum of 480 cfm of total outdoor air. To achieve the ASHRAE Standard, this supply of outdoor air limits classroom occupancy in relocatable classrooms to no more than 32 persons.

When specifying a new relocatable classroom, ensure that the HVAC system can: (a) provide the minimum outdoor air stated above; and (b) heat and cool this outdoor air at design outdoor temperatures for the specific geographic location where each classroom is installed. Some manufacturers of relocatable units do not include outdoor air intakes in their standard classroom models. It is important that an additional "outdoor air kit" be ordered for this purpose. Further, installation of an outdoor intake must be specified as part of the exhaust system. Lack of an exhaust in an HVAC system with an outdoor air intake will result in room pressurization, reduced outdoor air flow rates, and lower efficiency of removal of pollutants from the room.

Outdoor air must be supplied continuously when a classroom is occupied. Demand-controlled HVAC package systems often used in relocatable classrooms typically operate only when the temperature of a space is different from the thermostat's set point (i.e., higher in the winter, and lower in the summer). In order to provide a continuous outdoor air supply, it is important to ensure that the HVAC thermostats are set in the "on" or continuous mode when occupied.

State-leased relocatable classrooms are required to have HVAC systems that are wall mounted. Units acquired from other sources can have either wall- or roof-mounted HVAC; the cost of roof-mounted HVAC may

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be somewhat greater. However, some side-mounted units may be noisier, and it is important to check the noise level from HVAC operations in the relocatable classroom. If a noisy HVAC system is turned off because it interferes with classroom activities, this effects a failure of the ventilation requirement.

Air Filters for HVAC Supply Systems

Particle filters are needed for protection of HVAC components and reduction of airborne dust, pollens and microorganisms from recirculated and outdoor air streams. For relocatable classrooms, the DGS requires installation of a replaceable filter in the HVAC system. ASHRAE Standard 62-1989R requires filters with minimum of 25-30% dust spot efficiency (ASHRAE Standard 52.1) or >60% efficiency (ASHRAE Standard 52.2 for 3 micron particle). Where system design can accommodate them, filters with >65% efficiency for 1 to 3 micron particles will improve IAQ with respect to particles.

Renovating Classrooms

When school facilities are renovated for classroom use, it is imperative that new designs provide for adequate outdoor air in the renovated spaces. A common problem occurs when a large room is retrofitted with interior walls to create several, smaller rooms, and the required number of air supply outlets or return inlets is not installed. This results in inadequate ventilation in parts or all of the renovated rooms. Ensure that new designs are evaluated for ventilation adequacies.

Flooring materials

In most school classroom settings, hard flooring surfaces, such as commercial sheet flooring, are preferable to carpet: they are easier to keep clean, and they are not as prone to water damage or mold growth. However, the DGS State Portable Classroom Program requires that units be carpeted, except in certain areas, such as bathrooms. When carpets are specified, require the classroom manufacturer to install carpets that have been certified under the Carpet and Rug Institute's Indoor Air Quality Labeling Program.

Other important issues

- Site classrooms away from locations where: (a) vehicles idle, (b) water accumulates after rains, and (c) electric/magnetic fields (EMF) are high.
- Ensure that at least one supply air outlet and return air inlet are located in each enclosed area.
- Ensure that building air intakes are located away from any exhaust outlet(s) or other contaminant sources.
- Specify operable windows, to provide user-controlled ventilation when needed.
- Do not use carpet in entryways to classrooms with direct outdoor access. Otherwise, supply waterproof mats over carpeted entryways for drying of clothing and umbrellas.
- Check that special-use classrooms (e.g., for chemistry, biology, fine arts, etc.) have local exhaust ventilation (e.g., hoods or window fans).
- Locate HVAC and air handler units as far away as possible from teaching areas.
- Have insulation installed only on the outside surfaces (not inside) of air ducts.
- Ensure that HVAC ducts and plenums have easy access for inspection and cleaning.
- Specify that building materials used in construction (e.g., paints and adhesives) and room furnishings (e.g., particle-board bookcases) are certified as "low-emitting" for volatile organic compounds (VOCs).

B. CONSTRUCTION/INSTALLATION and FIRST-USE

Building construction and renovation create dust, emissions of volatile organic compounds (VOCs), and other work hazards and these are not compatible with normal school functions. A large proportion of building-related illness is associated with the improper use or storage of building materials in occupied areas. Therefore, every effort should be made to restrict construction activities to non-school hours and to ensure that building materials are stored away from occupied areas.

Isolate construction areas

During construction, it is important to isolate construction activities from occupied areas with a floor-to-ceiling barrier that will contain dust and vapor, such as plastic sheeting. Exhaust-to-outside ventilation in construction areas should be used at all times when dust or chemical vapors are generated.

Commission HVAC system in relocatable classrooms

Before a relocatable classroom is used, be certain that the HVAC system is fully inspected by a certified professional. Have him/her certify that it heats and cools properly, provides the appropriate amount of outdoor air, and operates continuously when the classrooms are occupied. The space pressure of the building should be slightly positive with respect to outdoors. Check the noise level in the classroom associated with HVAC operation. Confirm that outdoor air intakes are located away from contaminant sources (e.g., bus parking, kitchen exhaust, etc.).

"Flush-out" all newly constructed, remodeled, or acquired classrooms.

Prior to use of any new relocatable units by staff or students, operate HVAC systems at their maximum outdoor air intake rate continuously for several days. Similarly, provide maximum flush-out by HVAC (or open windows) for newly renovated classrooms and offices. Start this "flush-out" as soon as the HVAC system is operational, and continue after furniture installation. During this period, do not recirculate return air.

"Flush-out" not "Bake-out"

Building "bake-outs", i.e., when temperatures are increased up to _100°F in order to "artificially age" building materials, are not recommended. Their effectiveness has not been proven, and they may in fact damage parts of the HVAC system or building components.

Continue "flush-out" ventilation during periods of first use

Efforts to minimize exposures to school children and staff should continue in the weeks following project completion. Emissions of VOCs from building materials still pose problems during this time, when they are at their highest. This is done by delaying occupancy in renovated rooms and portable classroom for several weeks, and utilizing maximum outdoor air ("flush-out") ventilation during these periods and for the first weeks of use. Flush out periods of 1-2 weeks are recommend, although longer periods may be required. For the first days to weeks of occupant use, continue to operate HVAC systems at the maximum outdoor air setting. Finally, monitor occupants' comfort, and follow-up complaints to identify problems early.

Establish an Integrated Pesticide Management plan.

For a quick reference guide, see *Pest Control in the School Environment: Adopting Integrated Pest Management*, Report EPA 735-F-93-012 (available from the U.S. EPA Indoor Air Quality Information Clearinghouse, see below).

C. MAINTENANCE

The cost of new classrooms is an investment in the future of a school. It is clear that adequate maintenance is key to protecting this investment: *An ounce of prevention is worth a pound of cure.*

Designate specific personnel to perform specific tasks:

- Provide training on operation and maintenance of new HVAC equipment to appropriate staff.
- Be certain that operation and maintenance (O&M) documentation is kept readily accessible to staff servicing the system.
- Maintain documentation of completed tasks.
- Allocate sufficient staff time and funds for maintenance.
- Instruct teachers and staff on proper use and settings of thermostat and ventilation controls -- provide

each classroom with hardcopy (plastic-covered) instruction sheets.

Establish a regular and timely plan for testing, inspecting and performing specific maintenance tasks:

- Inspect roofs, ceilings, walls, floor, and carpeting for evidence of water leakage or infiltration, and for mold and mildew growth or odor. **Replace water-damaged materials.**
- Inspect air supply outlets and return air inlets, to ensure that they are open, operable and unobstructed.
- Check airflows rates at the outlets and inlets periodically.
- Inspect air plenums for mold growth, excess dirt, etc.
- Establish a periodic air filter replacement schedule.
- Clean condensate pans (monthly) and do not allow free standing water to accumulate.
- When carpets are cleaned, ensure that they dry thoroughly as soon as possible after the process is done.
- Provide for the proper storage of cleaning/janitorial supplies.
- Maintain documentation of completed tasks.

RELEVANT PUBLICATIONS

- *IAQ Tools for Schools Action Kit*. For information, contact the U.S. EPA IAQ Information Clearinghouse (see below). This kit provides guidance for achieving and maintaining good IAQ in your schools.
- *Indoor Air Quality: A Guide for Educators*. Available from the California Department of Education, School Facilities Planning Division (see below).
- *Building Air Quality: A Guide For Building Owners and Facility Managers*. Available from the Superintendent of Documents, FAX: 202-512-2250.
- *Pest Control in the School Environment: Adopting Integrated Pest Management*, Report EPA 735-F-93-012 (available from the U.S. EPA IAQ Information Clearinghouse (see below).
- *Indoor Air Quality / School Facilities Documents* (a set of 15 documents, such as "Maintaining Acceptable IAQ During the Renovation of a School", "Maintenance of HVAC Systems and IAQ in Schools", and "Equipment for Measuring Air Flow, Air Temperature, Relative Humidity, and Carbon Dioxide in Schools"). Available from the Maryland State Department of Education, Schools Facilities Branch, 410-767-0100.
- *Reducing Occupant Exposure to Volatile Organic Compounds (VOCs) From Office Building Construction Materials: Non-Binding Guidelines*. Also applicable to school building construction. Available from DHS' Indoor Air Quality Section, see below.
- *Electric/Magnetic Field (EMF) Checklist for School Buildings and Grounds Construction*. Available from DHS' EMF Program, see below.

ADDITIONAL CONTACTS

- U.S. EPA Indoor Air Quality Information Clearinghouse, 800-438-4318.
- California Department of Education, School Facilities Planning Division, 916-322-2470 (Ellen Aasletten).
- California Department of Health Services (DHS) Indoor Air Quality Section, 510-540-2469 (Jed Waldman), and Electric/Magnetic Fields Program, 510-450-3818 (M.A. Stevenson).
- California Air Resources Board, Indoor Air Quality/Personal Exposure Assessment Program 916-323-1504 (Peggy Jenkins).
- Cal/OSHA Consultation Service. Contact headquarters (415-972-8515) or area office.
- California Energy Resources, Conservation & Development Commission (CEC), 916-654-4287.
- California Department of General Service (DGS) Office of Public Construction, 916-323-0319 and Division of the State Architect, 916-445-2163.

- Carpet and Rug Institute, 800-882-8846.
- School Facilities Manufacturers Association,
- National Pesticide Telecommunications Network: 800-858-7378.

This advisory was produced by the *California Interagency Working Group on Indoor Air Quality* in December 1996. Direct correspondences or comments to:

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